Finally ADA's Comments

April16, 2003

MEMORANDUM

SUBJECT: Industrial Transformer Superfund Site (99-R06-002)

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TO: Ernest Franke, P.E., RPM
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Technical review comments are provided below on the *Feasibility Study Report For Remedial Alternatives, Sol Lynn Superfund Site, Houston, Texas* (FS), for the Sol Lynn/Industrial Transformer Superfund Site, Houston, Texas (the site). The FS presents the proposed remedial alternatives. General and specific comments are provided separately, below. Dr. Bruce Pivetz with Mantech Environmental Technology Inc. performed this review. If you have any questions or would like to discuss any of the comments and recommendations, please call me at (580) 436-8610.

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TECHNICAL REVIEW COMMENTS AND RECOMMENDATIONS

General Comments

1. Natural attenuation alone is not likely to result in remediation of the plume to MCLs within a reasonable time frame, due to the large plume and the presence of a source area. Active source area remediation will be necessary in conjunction with remediation of the downgradient dissolved contaminant plume (by monitored natural attenuation or in situ bioremediation) if MCLs are the desired remedial goal.

2. It is recommended that any pilot study or remedial action design include additional source characterization to more narrowly define the source area that will require active source remediation. The FS currently broadly defines a source zone to be *"a general region...within which a source can potentially exist."*

3. The Supplemental Remedial Investigation (RI) for the site indicated that there was extensive sample collection and analysis for natural attenuation and ground-water chemistry parameters (as stated in Sections 2.5.8, 2.5.8.1, and 2.5.8.2 of the Supplemental RI). These results were not discussed in the Supplemental RI, although the data were included in the electronic database. This reviewer recommended that the data be discussed in the FS; however, that does not seem to have been done (except for one sentence at the bottom of page 61). It is unclear how the natural attenuation and ground-water chemistry parameter results were interpreted and used. They could be useful in conjunction with the natural attenuation modeling simulations. It is recommended that these parameters be discussed in the FS.

4. Concerns about the parameter values used in the BIOCHLOR model simulations are discussed in the Specific Comments. The concerns raise questions about the applicability of the model simulations, and thus, of the conclusions based on those simulations. It is recommended that the parameter values and results of the model simulations be reexamined to alleviate these concerns, and that the model and simulations be refined as additional data are collected (as noted in the Summary and Conclusions of Appendix C).

There is more detailed discussion about the assumptions and interpretations of the modeling simulations in Attachment 1 (the INEEL report) of the FS than in Appendix C (Fate and Transport Modeling). However, the INEEL report discussed just the 30-year simulation (the current situation), not the 100-year simulation (what will occur 70 years from now). It is recommended that the 100-year simulation be discussed at a similar level of discussion, specifically, how the simplifying assumptions affect the simulation results over the longer span of time.

5. The Idaho National Engineering and Environmental Laboratory (INEEL) report, which is Attachment 1 of the FS, appears to be a thorough report which clearly discusses the assumptions and uncertainties associated with predicting the plume behavior and potential for

natural attenuation. Its sections 9 (Conclusions) and 10 (Recommendations) concisely discuss the important considerations for remediation of the site. It recommends conducting an evaluation of monitored natural attenuation, following the *EPA Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*. However, this screening step does not appear to have been discussed in the FS, even though the supplemental site characterization collected the necessary natural attenuation data.

6. There are inconsistencies in the FS regarding the presence of naturally occurring dechlorination at the site. Page ES-ii and page 26 state that "*The results also indicated that natural reductive dechlorination is ongoing.*"; however, Attachment 2, the Microcosm Study Report indicates that 15 out of 16 non-amended microcosms did not show any TCE dechlorination (p. 5). Page 22 of the FS states that the microcosm study showed that TCE degradation is accomplished by reductive dechlorination driven by "*other sources of organic carbon*", presumably "*naturally occurring organic matter*", since no other organic compounds were suspected of having migrated to depth with the TCE; however, it is then unclear why the non-amended microcosms, which presumably would contain the naturally occurring organic matter, did not show this reductive dechlorination. It is possible that some reductive dechlorination has occurred at the site, as shown by the presence of the trichloroethylene (TCE) daughter products 1,2-cis-dichloroethylene (DCE) and vinyl chloride (VC). However, the extent of naturally occurring reductive dechlorination is likely overstated in the FS.

Specific Comments

7 *3.2 Contamination Source Area.* The FS indicates that the vertical extent of contamination has not been defined in potential source areas A, B, and C. It is assumed that this refers to just the unsaturated zone soil, since the rest of the FS appears to indicate that the vertical extent has been defined in the ground water in the saturated zone; however, clarification is recommended. It is also recommended that the depth to which soil samples were collected be given since it is not clear if the lack of detection of DNAPL was for just the unsaturated zone or for the entire interval.

8 *3.4.2 Ground Water Transport, and Table 4.* The calculations of R use measured values of porosity that are different for each water-bearing zone (WBZ), yet uses the same bulk density for each WBZ (1.8 kg/L). Since bulk density changes as the porosity changes, assuming the type of solid material does not change, this usage is incorrect. However, the R values calculated using bulk density values consistent with the measured porosity (e.g., 1.51 kg/L for n = 0.43) does not change the R values significantly (e.g., the maximum difference is less than 5%). It is recommended, however, to always use bulk density and porosity values that are consistent in their physical interrelationship, in any calculations.

9 *3.5.2 Summary and Conclusions.* If the assumption that biodegradation rates are constant from the source area to the limit of the model extent is not true (i.e., they are less at the model limit), the model would over predict the DCE and VC concentrations, as stated; however,

it would also under predict the TCE concentrations. It is recommended that a statement to this effect be added.

10 *5.2.4.4 Steam Stripping.* Extraction wells can be used to extract horizontally-moving steam and contaminant from confined layers within the saturated zone.

6.4 Alternative 4: In Situ Bioremediation.

11 1. The FS states that "Organic contaminants are degraded...under anaerobic conditions...to methane..." This is true for petroleum hydrocarbons or for carbon tetrachloride and chloroform, but not for the chlorinated alkenes (TCE, DCE, and VC) found at the site. Ethene and ethane will be formed as byproducts from the site contaminants. It is recommended that this be clarified in the FS, as it will alleviate potential concern about the formation of methane. Methane could be present as a result of degradation of other organic compounds (or the lactate in the microcosm studies), and would indicate reducing conditions, but would not be a result of the reductive dechlorination of the site contaminants.

12 2. The FS indicates that a phased, alternating approach would be used to maintain anaerobic or aerobic conditions, presumably in one area and with anaerobic, then aerobic conditions. An approach in which the anaerobic and aerobic conditions are maintained concurrently, but in different locations, could be examined to see if it is feasible. The anaerobic conditions could be maintained in the source area to treat the more chlorinated compounds, and aerobic conditions could be maintained downgradient to treat the vinyl chloride.

7.2.2 Alternative 2 - Monitored Natural Attenuation. The discussion of this alternative with respect to the evaluation criteria appears overly optimistic. Specific examples are given below.

13 1. *7.2.2.2 Compliance with ARARs.* It is stated that this alternative complies with all ARARs; however, the MCLs will not be met for a long period of time. Table 6 indicates that the SWDA ARAR may require a conditional waiver; however, that is not discussed in the text (this concern also applies to the other alternatives).

14 2. *7.2.2.3 Long-term Effectiveness and Permanence.* The text states that the model indicates that the plume could "*extend 1,700 ft in 100 years*". This is somewhat misleading, as it implies that the plume will grow 1,700 feet over the next 100 years. Based on section 3.5 and Table 5, the current situation is taken as the 30-year simulation; thus what was really meant is the 100-year simulation (i.e., 70 years from now). Also, the total extent of the TCE plume in WBZ-3 will be 2,150 feet at the 100-year simulation, not 1,700 feet (the 1,700 ft figure may represent the cis-1,2-DCE plume in WBZ-3). Compared to a current (i.e., 30-year simulation) extent of 1,100 feet, this represents a 1,050 ft expansion in the next 70 years. It is recommended that the text be clarified.

The rate of expansion of the TCE plume in WBZ-3 is unclear. If it is constant, the plume could expand 150 feet in 10 years, yet the text indicates that it is not expected to be "*substantially different from its present state*", and that this ten-year period could provide the time for more substantive remediation methods to be implemented. It could be presumed that a 150-ft plume expansion is not substantial, yet, over longer periods of time, this rate of plume expansion will lead to a much larger plume. Also, delaying remediation another ten years until a more substantive remediation method is implemented, or the "*plumes begin to reach a point where they may become a threat to either human health or the environment*" may simply result in a larger and more difficult problem at the end of ten years. It is recommended that action be taken sooner, rather than later.

3. *7.2.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment.* The FS indicates that dissolved contaminants "*will continue to migrate on a limited basis*". An expansion of the plume (as defined by the TCE MCL in WBZ-3) by 1,050 feet in the next 70 years may not be considered "*limited*", and the expansion over a longer time period could be even greater.

4. *7.2.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment.* The FS states that toxicity will be reduced; however, this does not take into account the production of the more toxic and more mobile VC, which also has a lower MCL, as was pointed out in earlier sections of the FS.

5. *7.2.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment.* The statement that the contaminated volume will increase for several decades before it begins to decrease appears inconsistent with the previously stated plume expansion of 1,050 ft for TCE in WBZ-3 over the next 70 years.

7.2.4 Alternative 4 - In Situ Bioremediation.

1. Inoculation of microbial colonies in downgradient areas is mentioned as a possible strategy. In situ augmentation of bacteria, even indigenous bacteria, is a difficult strategy that has been shown to be successful at only a few sites, and would need to be proven effective in pilot scale tests.

2. It is unclear over what portion of the plume the in situ bioremediation would be implemented.

7.2.6 Alternative 6 - Dynamic Underground Stripping. This section does not include discussion of the potential enhancements to the DUS of electrical resistance heating and hydrous pyrolysis. It is recommended that they be mentioned, along with how their inclusion or omission affected the evaluation of the DUS technology.

7.2.7.3 Long-term Effectiveness and Permanence. The first sentence mentions "*DUS*"; however, what was probably meant was "*SEAR*".

Appendix A Tables

Table 5. This table would be more informative if it also included the current (i.e., 30-year simulation) plume extent. This would indicate the expected amount of plume expansion over the next 70 years as well as showing the extent of the plume 70 years from now (i.e., 100-year simulation).

Appendix C Fate and Transport Modeling

4.1 WBZ-1 Modeling Results.

1. There are inconsistencies between the K_{oc} values used in the model (Table 5 of Appendix C) versus the values given in Table 4 of the FS. Also, the bulk density value used (1.8 kg/L) is physically inconsistent with the total porosity value used (0.43). It would result in an under prediction of about 4% in the contaminant velocity for TCE in WBZ-1. See the comment for 3.4.2 for further explanation. In addition, the effective porosity value entered (0.43) is actually the total porosity value; whereas, the ground-water seepage velocity of 28 ft/yr entered into the model simulation is based on an effective porosity of 0.2. Although the BIOCHLOR simulations used the seepage velocity values that were entered directly using the correct effective porosity (0.2), rather than seepage velocity values calculated using the incorrect effective porosity (0.43), entering the incorrect effective porosity values into the model could be misleading and result in errors if a model-calculated seepage velocity were used in future simulations and these input values were not changed.

It is recommended that these inconsistencies be corrected, to provide more confidence in the model simulation results. The same concerns apply to the model simulations for the other WBZs.

2. A median retardation coefficient (R) of 1.38 was used to represent all the chlorinated ethenes in the model calibration, since BIOCHLOR uses a "common" or median R calculated from ethene and four default chlorinated ethenes (including tetrachloroethylene (PCE), which is not found at the site and which has the highest R value). Table 4 of the FS presents retardation coefficients for WBZ-1: 1.35 for TCE, 1.11 for DCE, and 1.04 for VC, thus, the median value of 1.38 is not correct for the contaminants found at the site. Failure to use representative retardation coefficients might explain the poor match for the field data and model results for DCE and VC. The retardation coefficient used for DCE and VC is higher than what was calculated (see Table 4) and would result in shorter and higher concentration plumes of these compounds, especially over long periods of time. This could be an alternative or additional explanation for the poor match, as opposed to the explanation presented in the FS that dechlorination rates were variable. Use of individual retardation coefficients specific to each compound and WBZ would result in more accurate predictions. The same concerns apply to the model simulations for the other WBZs. The BIOCHLOR user's manual recommends conducting a sensitivity analysis for varying values of R. It is recommended that this sensitivity analysis be conducted, or, if directly applicable, the

sensitivity analysis described in Attachment 1 (the Idaho National Engineering and Environmental Laboratory) should be discussed in the text of Appendix C, to alleviate these concerns. The sensitivity analysis in Attachment 1 indicates a plume length difference of over 100 feet for the 30-year simulation of the contaminants, when comparing the "0.5R" and "2R" values. The differences in plume length for a 100-year simulation likely would be greater.

5. *Summary and Conclusions.* One stated assumption used in the model is that biodegradation rates were constant from the source area to the limit of the model extent. As noted in the text, this is may not be an accurate representation of reality. It is recommended that future model simulations take this into account, perhaps by using the two-zone feature of BIOCHLOR, if appropriate.

Appendix D Technical Memorandum for Remedial Alternatives Screening

A review of this Technical Memorandum indicated that it appears to be an earlier version of the text in the body of the FS that describes and analyzes the Alternatives. Some of the same comments that are given above also apply to this text (e.g., the comment for *6.4 Alternative 4: In Situ Bioremediation*). There are statements in this Technical Memorandum that have been deleted or changed in the body of the FS (a few examples are given below), and additional subject matter is included in the FS (e.g., the Dynamic Underground Stripping and Surfactant Enhanced Aquifer Remediation). It appears that this Technical Memorandum has been superseded by the text in the body of the FS; thus, only the example comments, below, will be given.

It is recommended that this Appendix be deleted from the FS, or clearly marked as being an earlier version. Otherwise, it may cause more confusion than enlightenment. If there is new information that is applicable to the FS, it should be extracted and added to the main body of the FS.

1. *5.2.1 Alternative 1 - Monitored Natural Attenuation with Institutional Controls, Overall Protection of Human Health and the Environment* and *Long-term Effectiveness and Permanence*. The statements are made that modeling showed that there would be minimal areal expansion of the plume over the next 60 years, and that the plume would grow no more than 175 feet in 60 years. These statements appear unsupported, given the 1,050 ft TCE plume expansion in WBZ-3 over the next 70 years, as stated elsewhere in the FS.

2. *5.2.1 Alternative 1 - Monitored Natural Attenuation with Institutional Controls, Cost.* The total present worth cost is given as $769,142; however, in the body of the FS it is given as $1,411,429. The cost provided here used a lower cost for the initial five years of monitoring, than did the body of the FS.

Attachment 1 Idaho National Engineering and Environmental Laboratory (INEEL)

3.2 Other Groundwater Quality Data. It is stated that other ground water quality data

(chloride, nitrate, sulfate, total alkalinity, total organic carbon, dissolved oxygen, iron(II), turbidity, ethane, ethene, hydrogen, and methane) are presented in the RI/FS. Most, if not all, these data, were not discussed in the RI or FS (except for one sentence at the bottom of page 61 of the FS). It is recommended that these results be fully discussed in the body of the FS.

6 Model Results.

1. The model was calibrated by adjusting degradation rates within the recommended ranges included in BIOCHLOR, as shown in Table 1. However, it should be noted here, as it is in the BIOCHLOR model, that these recommended ranges are derived from field data from sites with high concentrations of electron donor. These is no supporting information presented in the FS that high concentrations of electron donor are present at the site. The assumption of the presence of high electron donor concentrations may not actually represent what may occur in all or most of the site (low electron donor concentrations), and could have resulted in an erroneous calibration, or incorrect explanations of why the calibrated model does not accurately represent the DCE and VC plumes. Section 3.4 (p. 22) of the FS indicates that the site is probably electron-donor limited. It is recommended that the impact of this assumption be fully discussed in the body of the FS.

2. A single biotransformation zone was used in the model simulations. As noted in the comment, above, for *Appendix C, 5. Summary and Conclusions,* it is recommended that the two-zone feature of BIOCHLOR be investigated for possible use in future model simulations.

Attachment 2 Microcosm Study Report

2. Summary and Discussion of Results, Natural Attenuation Evaluation in Non-amended Microcosms. The Microcosm Study Report states that no dechlorination of TCE occurred in 15 out of 16 well set microcosms that did not receive any electron donor. This appears to contradict the general impressions given in the FS that reductive dechlorination is occurring naturally throughout the site (see General Comment 6).

3. Result Tables, Table 1. It is unclear why Table 1 does not list all the microcosms listed in Table 2, mostly the "D3" microcosms.